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SOIL and WATER RESOURCES:

Research Priorities for the Nation

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Research Priorities for the Nation

Edited by

William E. Larson, Leo M. Walsh,
B.A. Stewart, and Don H. Boelter

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PREFACE

This publication represents the best collective judgment on research priorities by a group of informed and dedicated people concerned with the future role of our soil and water resources in meeting human needs. More than 100 scientists and leaders were invited to a National Workshop held February 23–27, 1981 in Madison, Wisconsin. The goal was to identify national research priorities regarding the uses, management, and conservation of our soil and water resources. Nine working panels were established—Water, Land, Humid Regions, Semi-Arid and Arid Regions, Policy, Forest Land, Rangeland, Urban and Recreational Lands, and Drastically Disturbed Lands. A unique feature of this Workshop was the establishment of cross-review panels—Resource Base, Soil Productivity, Socio-economic Impacts, Water Quality/Quantity, and Energy Constraints—to provide interactive dialogue among panels and to make certain that these important issues were addressed. Panel chairmen prepared working papers for use at the Workshop. The papers formed the basis for discussion and provided a background for selecting research priorities. Each panel revised the working papers during the Workshop to incorporate the collective judgments of panel members, and of the cross-review panels. Panels also summarized their deliberations and listed priority research needs. The summaries provided the foundation for selecting the six most important research priorities for the nation.

These Workshop Proceedings contain an introduction, a listing of the most important national research needs, working papers of the panels, presentations of the five featured speakers, and the names and affiliations of the participants. The Proceedings are provided for those interested in an in-depth look at the material used by the panels to develop priority research needs. An Executive Summary was developed as a separate publication to present the highlights of the Workshop. The Executive Summary contains an introduction, a listing of the most important national research needs, summaries of the nine panel reports and recommendations, and a list of the Workshop participants.

We are confident that the information provided from this Workshop will catalyze the efforts of those concerned with the care of our soil and water resources.

SOIL AND WATER RESEARCH IN TRANSITION

Can we sustain the productivity of America's soil and water resources into the next century?

This question preoccupies the minds of many scientists and agricultural leaders today. It should be of concern to all Americans.

Most Americans take soil and water resources for granted. Near-phenomenal advances in agricultural science and technology have produced a seemingly unending supply of food and fiber for domestic and export uses. First there was hybrid corn, and then improved management of crops and animals, increased use of agricultural chemicals, and use of more efficient machines. Not unrelated to agriculture's enormous growth in productivity were cheap energy and favorable weather.

But the realities of American food and fiber production changed in the 1970's. What had been an era of abundance in the 1960's suddenly took on the appearance of an era of scarcity. Export demand for food and fiber crops rose dramatically, energy almost overnight became less accessible and much more expensive, and weather seemed to be more variable.

America's farmers and ranchers responded by putting an additional 54 million acres of idle land into production. The price paid by American consumers and overseas purchasers of food and fiber remained reasonable, but the toll on land and water resources proved high. National resource inventories conducted by the U.S. Department of Agriculture showed that soil erosion was excessive for maintaining productivity on a fourth of the nation's 413 million acres of cropland. In the heart of the Corn Belt, average annual loss was put at two bushels of soil for each bushel of corn produced. Increased production also resulted in the use of irrigation water at a rate that cannot be sustained in many areas west of the Mississippi River, and water quality declined measurably in many parts of rural America. Today, agricultural researchers realize to what extent advances in science and technology had actually masked the damage to the land. Soil and water resources took on the quality of finiteness.

This perception was further enhanced in the report of the National Agricultural Lands Study released in January, 1981. Competition for land

intensified in the past decade, the report said, to the point that only 127 million acres of additional cropland with high or medium potential remain available. Noting that 3 million acres of agricultural land are now lost to nonagricultural uses each year, the study concluded that domestic and export needs for food and fiber will likely require that all available acres be in production by the year 2000. This study group also noted that pressure on the land will be even greater if erosion is allowed to continue to reduce soil productivity.

While much concern rightly exists about the management of our nation's cropland, similar concerns are being expressed about our range, forest, recreational, urban, and disturbed lands. The U.S. Department of Agriculture estimates that one-third of our rangeland is inadequately managed for their long-term protection. Yet we may have to increase pressure on these lands for our red-meat production as we increase pressure on cropland for our grain production. Forest lands are being damaged by erosion, soil compaction, and nutrient removal. Forest lands also are being lost to agricultural uses and mining. Yet they are increasingly being used for recreation, wildlife, and aquatic habitat, as well as for timber and paper production. As we intensify mining for coal and other minerals, the need to reclaim these lands and protect associated water resources will be great.

America's dedicated farmers, ranchers, and foresters have expressed their concern about the degradation of soil and water resources. Others are equally disturbed. Those interested in wildlife, wetlands, and wilderness have expressed their anxieties in many ways.

It was in this setting that more than 100 of the nation's best scientists and leaders in agriculture and natural resources met the week of February 23, 1981 in Madison, Wisconsin, to discuss soil and water research priorities. Knowing that public funds for research are limited, knowing that enhanced productivity is the watchword of the day throughout the nation, and knowing that most Americans think of agriculture almost solely in terms of their food supply and its cost, the charge given to participants was twofold. First, what research is needed to ensure the care and maintenance of the nation's soil and water resources into the next century? Second, how will this research make a difference in the lives of people?

Research, of course, is an integral part of efficient food and fiber production. It is inextricably linked with education, extension, and action programs. Fortunately, America's farmers, ranchers, and foresters show a remarkable penchant for innovation and using new technology.

Past efforts have concentrated on production-oriented research, and we can be proud of these achievements. This research reduces food costs at home, provides for exports to help with our balance of payments, and gives the world a few more years to bring food needs and production into balance. Furthermore, the payoff has been substantial—on the order of a 50% annual return on research expenditure.

In some respects, however, agricultural research has been a victim of its success. Society's preoccupation with the technological aspects of agriculture, coupled with the crop surpluses of the 1960's, tended to dampen the public's enthusiasm for funding research—and these factors led to an in-

sensitivity to the exploitation of soil and water resources. Federal support for soil and water research has remained nearly constant since 1966. Agricultural productivity, which grew at an annual rate of 2.1 percent between 1939 and 1965, has since fallen to 1.7 percent. For some crops, officials in the U.S. Department of Agriculture contend that productivity has reached a plateau.

Production-oriented research must and will continue in both the public and private sectors, particularly the latter, where the short-term payoff sells well. In the case of soil and water protection, however, public research must do what private research cannot undertake because of the uncertainty in payoff. But it is precisely this type of research that no nation, including the United States, can ignore. Prolonged strength in the national economy can not rely on a public policy of resource exhaustion.

Landowners and managers have not always used the best soil and water conservation practices. This fact is understandable because such practices have not always been cost effective. Just as the farmer has been reluctant to use conservation practices because of economic constraints, the public has been reluctant to fund conservation research because of low cost-benefit ratios. However, with increasing costs of energy and additional pressures on our soil and water resources, conservation practices are rapidly becoming production inputs. This change is already evident in many irrigated areas where water conservation is reducing energy costs and also allowing more land to be irrigated. As conservation practices become increasingly important as production inputs, public support for such research should improve, and farmers will more likely use the findings.

We must readdress the role of agricultural research in relation to long-term national needs, particularly research concerned with the care and maintenance of the soil and water resources that underpin much of our agricultural productivity. To avoid doing so ultimately may prompt embarrassing questions about the consequences to farmers, to consumers, to the national economy, and to those people around the world who have come to depend upon this country for aid and a dependable source of reasonably priced food and fiber products.

The research priorities established at this workshop were based on the assumption that innovative, basic research must be continued and expanded. Unless we make a commitment to basic research and restock our storehouse of fundamental knowledge, meeting the soil and water research imperatives identified at this workshop will be impossible.

PRIORITIES FOR THE NATION

Each of the nine panel reports was carefully considered in developing the six most important research priorities for the nation. These priorities, which address the most important concerns of each panel, are as follows:

SUSTAINING SOIL PRODUCTIVITY

One-third of the cropland and much of the range and forest lands of the nation are eroding rapidly. Research is needed to quantify the relationship between plant growth and those soil attributes affected by erosion. Once we understand this relationship, we can evaluate periodically the nation's continuing ability to produce food and fiber. This, combined with a knowledge of erosion processes, will enable us to develop the best management practices for controlling erosion on specific soils.

DEVELOPING CONSERVATION TECHNOLOGY

As our soil and water resource base becomes more fully utilized, the development of conservation technology that provides adequate protection from degradation is imperative. Resulting practices must be cost-effective and energy efficient, and must protect against all forms of soil damage, including erosion, salinity, and compaction. Technology that should receive emphasis includes conservation tillage for cultivated land, management of crop residues and organic wastes, reclamation of erosion-depleted soils and disturbed lands, nutrient management of all lands, and rehabilitation and management of rangeland and forest lands.

MANAGING WATER IN STRESSED ENVIRONMENTS

Large acreages of crops are now grown under water-stressed conditions on non-irrigated land and under limited irrigation in semi-arid regions. In the future, this acreage of water-stressed crops will increase because of increasing competition from other water users, declining ground water levels, and bringing fragile lands that have low water-holding capacity into production. Consequently, we must improve strategies and practices to increase total water yield and efficient water use.

Examples of such strategies for irrigated agriculture are: increasing water-application efficiency; predicting accurately when and how much water is needed; using irrigation return flow; and using water of impaired

quality. For non-irrigated areas, examples are: developing varieties and species that require less water; improving fallow and overwinter water-storage efficiencies; and developing water-conserving tillage practices.

PROTECTING WATER QUALITY

All land uses affect the quality of surface and ground water. Research must determine the relations involved in transport of sediments and chemicals by surface and subsurface flow to permit prediction and development of land management practices. The consequences of certain contaminants in water are difficult to delineate because they depend greatly on time, location, and intended use. The effects of specific pollutant levels must be assessed in terms of subsequent water use, so that arbitrary and capricious standards are not established.

IMPROVING AND IMPLEMENTING CONSERVATION POLICY

The basic factors that influence the effectiveness of soil and water conservation policies involve questions of institutional arrangements and the assignment of responsibilities among various levels of government—federal, state, and local. These arrangements influence adoption of resource conservation practices through economic and other benefits, perceived or real. But the interactions among the policies of the various levels of government on adoption of resource conservation are not clear. Research is needed to quantify the effect of alternative policies on adoption of soil and water conservation practices.

ASSESSING SOIL AND WATER RESOURCES

The nation is becoming increasingly concerned about the amount and quality of its soil and water resource base. But methods for assessing the status of and changes in the resource base are inadequate. Land and water resource data need to be consistently and accurately collected, assembled, and maintained for all parts of our nation. Technology is needed for data collection through a combination of ground, aircraft, and satellite acquisition systems, along with efficient data analysis.

Epilogue

This workshop marks a new era in cooperative planning for soil and water research. The enthusiasm and dedication of the participants and sponsoring organizations were outstanding. A program for improved communication must be initiated with scientific, producer, industry, and policy groups. Dialogue with these groups will provide background for periodic updating of research needs. Our goal is to provide the best possible research information regarding the use, management, and conservation of soil and water resources.